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Gamma background radiation measuring in South -West region of Hungary

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Introduction

Natural radioactive gamma background consists of the gamma radiation of naturally occurring radioisotopes of uranium and thorium decay series, the only radioactive isotope of potassium K^{40}, and the Cs^{137} which is an isotope derived from the Chernobyl accident. It has a sufficiently long half-life to have considerable impact on the gamma background. The whole radiation background is superposed from these components and gives a quite complicated spectrum. Mainly the geology and the migration of the radioactive minerals determine the distributions of the natural radioisotopes, but the relief soil, hydrology and even human activity dependent migration is possible on a local scale.

Gamma radiation spectra have been measured in 58 measuring points in the East of Mecsek, in the Bükkösd area. In 2004 this region geophysical research is managed by the Radiometric Laboratory of the Geophysical Institute of Hungary. Gamma radiation spectra have been measured in 500*500 m network to asses the distribution of gamma radiation background. The survey was limited to the three natural components of gamma radiation U, Th series and K^{40}, and the Cs^{137}. The amount of data provides an opportunity to study the relationship between natural gamma background and regional geological feature. It also allows a study of temporary and geographical variations in gamma radiation levels in this region.

Methods

The survey has been carried out with a CANBERRA measuring system based on a portable liquid nitrogen cooled high purity germanium (HPGE) semiconductor detector of high spectral sensitivity. The energy resolution of the detector is 2.0 keV (measured on the 1330 keV line of Co-60). The detector was placed on a tripod 1 meter above the ground level on a grassy and uncultivated place. At each point the whole spectra has been recorded from 0 to 1500 keV. Simultaneously a portable EasySpec with 3*3" NaI crystal (CANBERRA) has also been used. In this case we measured on the ground level and the spectrum has been recorded from 0-2100 keV. The characteristic measuring time with HpGe detector and EasySpec was 2000s and 1800 s respectively. Before measuring the background, common spectra of Cs^{137} and Co^{60} sources have been recorded in order to check the measuring system and to eliminate the diverse effects which can cause undesirable variation (geometry, vegetation, etc.). In this case the characteristic measuring time is 200 s.

Data processing has been performed using SAMPO-90 software (CANBERRA) in case of the spectrums of the HpGe detector and PCA-4KN (KFKI) software in case of the spectrum of the EasySpec. In both case the first step is the energy calibration based on some characteristic peaks of the recorded spectra. This calibration provides the parameters of the linear channel-energy relation. Then the area of the most important identified peaks has been calculated for the four components (U, Th, K^{40}, and Cs^{137}) to determine the intensity of radiation emitted. Each intensity has been divided by the intensity of the Co^{60} source. The total intensity has also been calculated.

Conclusion

1:10000 Contour maps have been created for the four components, for the total intensity of gamma radiation and for the distribution of the intensity of dose rate. The map of Uranium, Thorium and Potassium show quite the same pattern. The intensity values of these three radionuclids reflects there concentration in the minerals in the soils. It is common to find them in the fined grain fraction such as clay. However observed discrepancies can be explained by the phenomenon of the disequilibrium of the uranium decay series, while thorium decay series is often un equilibrium. The pattern of the intensity of the Cs^{137} depends upon the primary fall out and furthermore on the migration of the soil.